

OPEN-POROUS CERAMICS FOR BIO-APPLICATIONS

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ABSTRACT: There are many different approaches how to produce porous ceramics containing more than 60 vol% of air: i.e. the replica method, the sacrificial template method and the direct foaming of liquid suspensions ^[1]. The direct foaming method is of particular interest due to its simplicity, low cost process, versatility and potential for in-situ applications.

We present here a novel direct foaming method which produces foams that are stable against bubble coarsening and drainage in the wet state. This stability is reached through the irreversible adsorption of particles onto the air-water interface. Upon drying and heat treatment or introducing of a setting agent, porous ceramic bulk material can be produced ^[2].

The aim of this work is to elaborate a tool to further control the microstructure of these porous ceramics, namely the open porosity and the pore size. The results show that upon combining a controlled destabilization of the wet foams with a non-toxic setting reaction such as a calcium aluminate cement reaction, the pore size and the open porosity can be tailored within a wide range, featuring porosities of 75 to 95 vol% air and pore sizes between 75 µm and 1 mm. Preliminary results with sintered (heat treated) calcium alumina samples demonstrate the potential of these foams to host cells of different types. We have observed that human osteosarcoma and endothelial cells attached to the material after 24 hours of incubation, proliferated for up to 4 days and colonized the entire cross-section of the ceramic. The non-toxicity of these foams was also evidenced.

Further work is now being done towards processing of calcium phosphate materials and in a later step to possibly produce injectable open-porous bone cements.

REFERENCES:

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2. Gonzenbach, U.T., et al., *Ultrastable particle-stabilized foams*. Angewandte Chemie-International Edition, 2006. 45(21): p. 3526-3530.